PB-248 762

HIGHLAND SILVER LAKE, MADISON COUNTY, ILLINOIS

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Environmental Research Center

June 1975

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1. REPORT NO.	2.
3. RECIPIENT'S ACCESSION NO.	
4. TITLE AND SUBTITLE: Report on Highland Silver Lake, Madison County, Illinois	5. REPORT DATE: Prepared June 1975
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S): Anonymous (National Eutrophication Survey Staff)	8. PERFORMING ORGANIZATION REPORT NO.: Working Paper # 306
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Pacific Northwest Environmental Research Laboratory U.S.Environmental Protection Agency 200 S. W. 35th St. Corvallis, Oregon 97330	10. PROGRAM ELEMENT NO.: 1BA029 11. CONTRACT/GRANT NO.:
12. SPONSORING AGENCY NAME AND ADDRESS: Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460	13. TYPE OF REPORT AND PERIOD COVERED: Final - 1972 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES: Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN-ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

PRICES SUBJECT TO CHANGE

18. DISTRIBUTION STATEMENT: Release unlimited	19. SECURITY CLASS (This Report)	21. NO. OF PAGES: 41
ia	20. SECURITY CLASS (This page)	22. PRICE: 4.00-2.25

EPA Form 2220-1 (9-73)

PB 248 762

026109

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

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REPORT

ON

HIGHLAND SILVER LAKE

MADISON COUNTY

ILLINOIS

EPA REGION V

WORKING PAPER No. 306

WITH THE COOPERATION OF THE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

AND THE

ILLINOIS NATIONAL GUARD

JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Illinois Environmental Protection Agency for professional involvement and to the Illinois National Guard for conducting the tributary sampling phase of the Survey.

Dr. Richard H. Briceland, Director of the Illinois Environmental Protection Agency; and Ronald M. Barganz, State Survey Coordinator, and John J. Forneris, Manager of Region III, Field Operations Section of the Division of Water Pollution Control, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

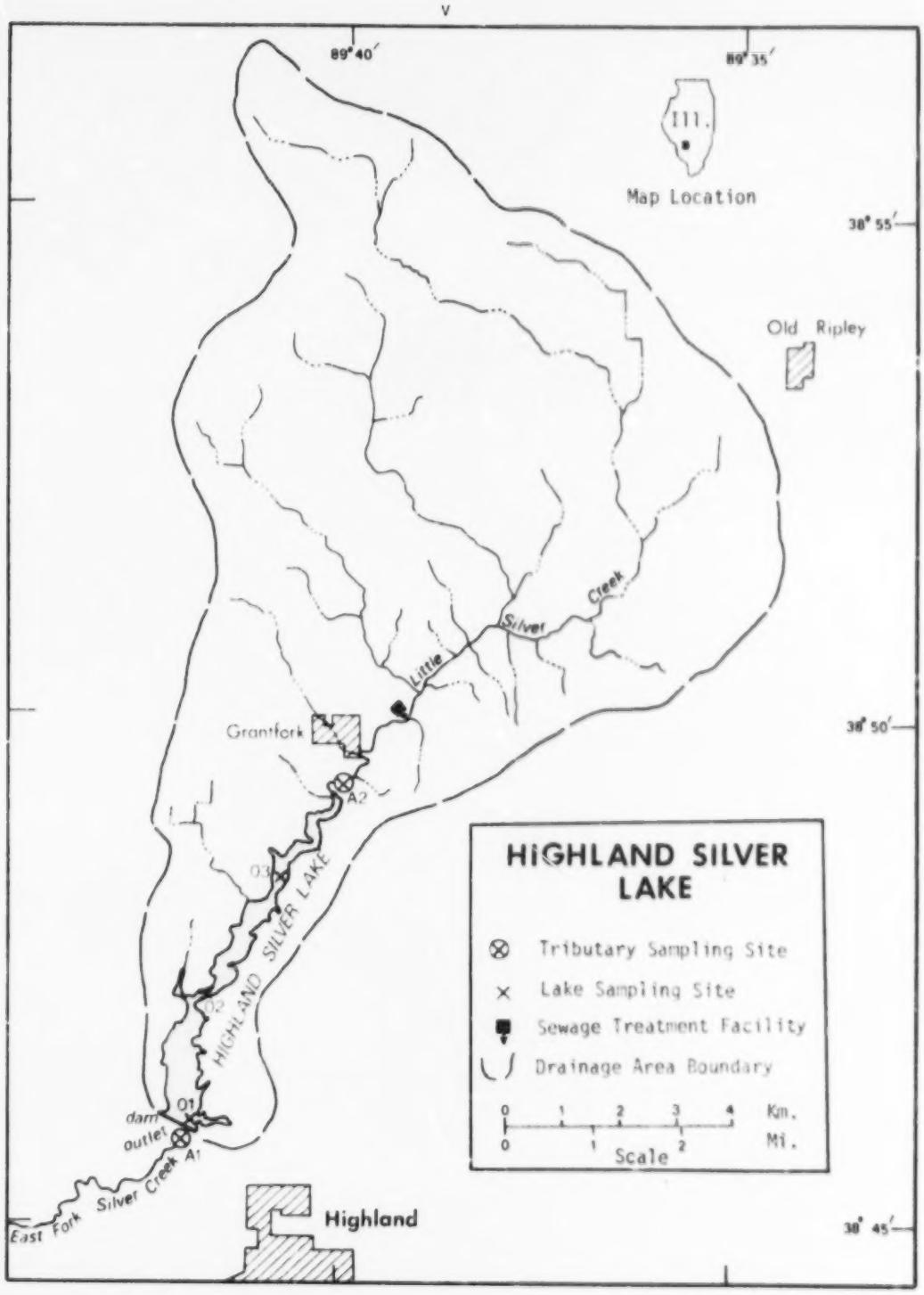
Major General Harold R. Patton, the Adjutant General of Illinois, and Project Officer Colonel Daniel L. Fane, who directed the volunteer efforts of the Illinois National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF ILLINOIS

LAKE NAME	COUNTY
Baldwin	Randolph
Bloomington	McLean
Carlyle	Bond, Clinton, Fayette
Cedar	Lake
Charleston	Coles
Coffeen	Montgomery
Crab Orchard	Jackson, Williamson
Decatur	Macon
DePue	Bureau
East Loon	Lake
Fox	Lake
Grass	Lake
Highland Silver	Madison
Holiday	LaSalle
Horseshoe	Madison
Long	Lake
Lou Yaeger	Montgomery
Marie	Lake
Old Ben Mine	Franklin
Pistakee	Lake, McHenry
Raccoon	Marion
Rend	Franklin, Jefferson
Sangchris	Christian
Shelbyville	Moultrie, Shelby
Slocum	Lake
Springfield	Sangamon
Storey	Knox
Vandalia	Fayette
Vermilion	Vermilion
Wee Ma Tuk	Fulton
Wonder	McHenry


89° 40′
89° 35′
Ill.
Map Location
38° 55′
Old Ripley
Little Silver Creek
Grantfork
38° 50′
A2
O3
HIGHLAND SILVER LAKE
O2
dam
outlet
O1
A1
East Fork Silver Creek
Highland
38° 45′
HIGHLAND SILVER LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
0 1 2 3 4 Km.
0 1 2 Mi.
Scale

HIGHLAND SILVER LAKE

STORET NO. 1740

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Highland Silver Lake is eutrophic. It ranked 23rd in overall trophic quality when the 31 Illinois lakes sampled in 1973 were compared using a combination of six lake parameters*. Twenty-four of the lakes had less median total phosphorus, 17 had less and one had the same median dissolved phosphorus, and 16 had less median inorganic nitrogen; but only mesotrophic Cedar Lake** had less mean chlorophyll a. The relatively low concentrations of chlorophyll a at sampling stations 1 and 2 and the high nutrient levels indicate primary productivity probably was light-limited. Twenty-seven of the lakes had greater mean Secchi disc transparency, and the Survey limnologists noted that the lake was quite turbid at all sampling times.

Marked depression of dissolved oxygen with depth occurred at stations 1 and 2 in August, 1973 (station 3 was not sampled at depths greater than 1.2 meters).

B. Rate-Limiting Nutrient:

The algal assay results indicate nitrogen was the limiting nutrient at the time the sample was collected (05/07/73).

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* See Appendix A.
** Working Paper No. 298.

However, the lake data indicate phosphorus limitation in August and October; the mean N/P ratios were 18/1 and 25/1, respectively.

C. Nutrient Controllability:

1. Point sources--The phosphorus contribution of the only known point source, Grantfork Elementary Center, accounted for 0.9% of the total load reaching Highland Silver Lake during the sampling year. Shoreline septic tanks were estimated to have contributed less than 0.1%.

The present phosphorus loading rate of 3.04 $g/m^2/yr$ is over five times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic rate (see page 14). However, on the basis of Survey data, it does not appear that phosphorus control at the Grantfork Elementary Center would result in a significant change in the trophic condition of Highland Silver Lake.

2. Non-point sources--The phosphorus load from non-point sources amounted to 99.1% of the total reaching the lake during the sampling year. The only measured tributary, Little Silver Creek, contributed 83.5%. The ungaged drainage area was estimated to have contributed 15.0% of the total phosphorus load.

The phosphorus export rate of Little Silver Creek was 75 kg/km^2/yr (page 14). This is somewhat higher than the rates of some of the tributaries elsewhere in the Kaskaskia River drainage; e.g., Hickory Creek (a tributary of Carlyle Reservoir*) had a phosphorus export rate of 25 kg/km^2/yr, and Raccoon Creek (a tributary of Raccoon Lake**) had a phosphorus export rate of 36 kg/km^2/yr.

The higher phosphorus export rate of Little Silver Creek may have been due to differing land-use practices and/or urban drainage from the village of Grantfork (1970 population = 162).

* Working Paper No. 297.
** Working Paper No. 312.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 2.99 kilometers^2.
2. Mean depth: 4.2 meters.
3. Maximum depth: >7.3 meters.
4. Volume: 12.558 x 10^6 m^3.
5. Mean hydraulic retention time: 189 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Little Silver Creek	100.8	0.63
Minor tributaries & immediate drainage -	18.2	0.14
Totals	119.0	0.77

2. Outlet -

East Fork, Silver Creek	122.0**	0.77

C. Precipitation***:

1. Year of sampling: 127.8 centimeters.
2. Mean annual: 94.9 centimeters.

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† Table of metric conversions--Appendix B.
†† Forneris, 1973.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Highland Silver Lake was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and generally from several depths at each station (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 7.3 meters at station 1, 4.6 meters at station 2, and 1.2 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR SILVER LAKE (HIGHLAND)
STORET CODE 1740

PARAMETER	1ST SAMPLING (5/ 7/73) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/10/73) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/17/73) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	16.3 - 17.1	16.7	16.7	21.3 - 27.4	25.6	26.3	18.4 - 19.4	18.9	18.9
DISS OXY (MG/L)	5.4 - 7.7	6.5	6.5	0.2 - 5.6	3.0	4.2	7.4 - 7.8	7.6	7.7
CNDCTVY (MCROMO)	185. - 220.	198.	195.	219. - 240.	224.	223.	188. - 198.	191.	189.
PH (STAND UNITS)	7.0 - 7.7	7.5	7.6	6.8 - 7.6	7.2	7.3	7.6 - 7.8	7.7	7.7
TOT ALK (MG/L)	52. - 71.	57.	55.	57. - 81.	66.	68.	62. - 76.	72.	74.
TOT P (MG/L)	0.226 - 0.271	0.247	0.249	0.182 - 0.560	0.315	0.205	0.091 - 0.140	0.107	0.103
ORTHO P (MG/L)	0.041 - 0.084	0.070	0.078	0.051 - 0.109	0.070	0.058	0.024 - 0.049	0.035	0.035
NO2+NO3 (MG/L)	0.400 - 0.930	0.722	0.720	0.200 - 1.200	0.796	0.980	0.620 - 1.000	0.826	0.850
AMMONIA (MG/L)	0.160 - 0.380	0.189	0.150	0.110 - 1.120	0.453	0.190	0.050 - 0.180	0.063	0.060
KJEL N (MG/L)	0.900 - 1.500	1.056	0.900	1.100 - 3.000	1.843	1.600	0.600 - 0.800	0.714	0.700
INORG N (MG/L)	0.770 - 1.050	0.911	0.880	1.100 - 1.360	1.249	1.310	0.680 - 1.100	0.889	0.900
TOTAL N (MG/L)	1.580 - 2.030	1.778	1.780	2.300 - 3.240	2.639	2.600	1.320 - 1.700	1.540	1.590
CHLRPYL A (UG/L)	1.3 - 16.2	6.3	1.3	1.4 - 12.0	5.4	2.9	2.2 - 12.6	5.8	2.5
SECCHI (METERS)	0.2 - 0.3	0.2	0.3	0.2 - 0.2	0.2	0.2	0.3 - 0.5	0.4	0.4

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal units per ml
05/07/73	1. Flagellates	880
	2. Cryptomonas sp.	440
	3. Glenodinium sp.	147
	4. Trachelomonas sp	59
	5. Euglena sp	29
	Other genera	147
	Total	1,702
08/10/73	1. Blue-green filaments	469
	2. Merismopedia sp.	388
	3. Flagellates	388
	4. Cyclotella sp.	245
	5. Melosira sp.	184
	Other genera	306
	Total	1,980
10/17/73	1. Centric diatom	1,378
	2. Melosira sp.	418
	3. Cyclotella sp.	274
	4. Trachelomonas sp.	212
	5. Cryptomonas sp.	103
	Other genera	727
	Total	3,112

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/07/73	01	1.3
	02	1.3
	03	16.2
08/10/73	01	1.4
	02	2.9
	03	12.0
10/17/73	01	2.2
	02	2.5
	03	12.6

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.100	0.855	23.3
0.050 P	0.150	0.855	27.6
0.050 P + 1.0 N	0.150	1.855	47.2
1.0 N	0.100	1.855	42.1

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Highland Silver Lake was high at the time the sample was collected.

There was a significant increase in yield compared to the control when only nitrogen was added (the slight increase when only phosphorus was added is not considered

significant). Based on these results, nitrogen limitation is indicated at the time the sample was collected (05/08/73).

The lake data indicate phosphorus limitation in August and October; the mean inorganic nitrogen to orthophosphorus ratios were 18 to 1 and 25 to 1, respectively, and phosphorus limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Illinois National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of March when two samples were collected. Sampling was begun in June, 1973, and was completed in May, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Illinois District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the adjusted nutrient loads, in $kg/km^2/year$, at station A-2 and multiplying by the ZZ area in km^2.

The operator of the Grantfork Elementary Center wastewater treatment plant provided monthly effluent samples and corresponding flow data.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Grantfork Elementary Center*	61	sand filter	26.5	Little Silver Creek

2. Known industrial - None

* Barney, 1973 (student population is 110; school in use 8 hours/day, 5 days/week, and 9 months/year).

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Little Silver Creek	7,595	83.5
b. Minor tributaries & immediate drainage (non-point load) -	1,365	15.0
c. Known municipal STP's -		
Grantfork Elem. Center	85	0.9
d. Septic tanks* -	<5	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	50	0.5
Total	9,095	100.0

2. Outputs -

Lake outlet - E. Fk., Silver Creek	7,075

3. Net annual P accumulation - 2,020 kg.

* Estimate based on four shoreline dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Little Silver Creek	51,535	79.8
b. Minor tributaries & immediate drainage (non-point load) -	9,300	14.4
c. Known municipal STP's -		
Grantfork Elem. Center	465	0.7
d. Septic tanks* -	40	0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	3,230	5.0
Total	64,570	100.0

2. Outputs -

Lake outlet - E. Fk., Silver Creek	60,485

3. Net annual N accumulation - 4,085 kg.

* Estimate based on four shoreline dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Little Silver Creek	75	511

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m²/yr	3.04	0.68	21.6	1.4

Vollenweider loading rates for phosphorus (g/m²/yr) based on mean depth and mean hydraulic retention time of Highland Silver Lake:

"Dangerous" (eutrophic rate)	0.56
"Permissible" (oligotrophic rate)	0.28

V. LITERATURE REVIEWED

Barney, Robert (Principal), 1973. Treatment plant questionnaire (school facilities). Highland.

Forneris, John J., 1973. Personal communication (lake morphometry). IL Env. Prot. Agency, Springfield.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1703	LAKE BLOOMINGTON	0.050	5.730	464.667	26.200	14.800	0.020
1706	LAKE CARLYLE	0.084	1.270	477.889	17.367	11.000	0.032
1708	LAKE CHARLESTON	0.160	4.680	490.667	12.000	8.400	0.065
1711	COFFEEN LAKE	0.032	0.260	456.222	7.700	14.900	0.012
1712	CRAB ORCHARD LAKE	0.082	0.700	482.222	59.867	13.800	0.013
1714	LAKE DECATUR	0.129	3.750	474.571	43.000	14.500	0.062
1725	LONG LAKE	0.704	1.190	482.667	49.333	8.800	0.398
1726	LAKE LOU YAEGER	0.186	1.600	489.583	10.662	11.400	0.076
1727	LAKE MARIE	0.098	0.370	467.667	39.533	14.700	0.057
1733	PISTAKEE LAKE	0.203	0.370	485.667	75.867	7.000	0.062
1735	REND LAKE	0.071	0.210	471.500	23.533	12.700	0.012
1739	LAKE SHELBYVILLE	0.062	3.290	461.333	17.161	14.800	0.019
1740	SILVER LAKE (HIGHLAND)	0.226	0.970	489.500	5.822	14.800	0.057
1742	LAKE SPRINGFIELD	0.108	3.265	483.385	13.013	10.800	0.059
1748	VERMILION LAKE	0.109	4.695	481.500	31.150	14.200	0.050
1750	WONDER LAKE	0.426	0.890	486.000	98.533	7.800	0.132
1751	LAKE STORY	0.072	2.510	459.333	17.250	14.800	0.021
1752	DEPUE LAKE	0.438	4.050	490.000	58.833	7.600	0.276
1753	LAKE SANGCHRIS	0.050	1.970	475.417	19.242	14.500	0.009
1754	LAKE HOLIDAY	0.167	3.135	485.167	51.217	7.200	0.046
1755	FOX LAKE	0.219	0.375	486.167	63.850	8.800	0.083
1756	GRASS LAKE	0.301	0.820	481.000	83.500	5.900	0.093
1757	EAST LOON LAKE	0.076	0.120	450.000	22.300	14.900	0.014
1758	SLOCUM LAKE	0.865	0.200	487.333	221.100	5.800	0.362
1759	CEDAR LAKE	0.029	0.170	400.333	5.767	12.800	0.013
1761	LAKE WEMATUK	0.069	1.770	466.333	7.967	14.500	0.031
1762	RACCOON LAKE	0.106	0.310	484.333	19.217	13.800	0.020
1763	BALDWIN LAKE	0.044	0.140	461.167	11.333	13.200	0.007

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P
1764	LAKE VANDALIA	0.116	0.480	478.111	11.276	14.800	0.023
1765	OLD BEN MINE RESERVOIR	0.930	0.205	478.333	31.433	11.200	0.575
1766	HORSESHOE LAKE	0.127	0.705	482.833	182.250	6.800	0.018

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NU
1703	LAKE BLOOMINGTON	88 (26)	0 (0)	80 (24)	47 (14)	13 (2)	68 (20)	296
1706	LAKE CARLYLE	63 (19)	40 (12)	63 (19)	63 (19)	63 (19)	53 (16)	345
1708	LAKE CHARLESTON	37 (11)	7 (2)	0 (0)	77 (23)	77 (23)	27 (8)	225
1711	COFFEEN LAKE	97 (29)	77 (23)	93 (28)	93 (28)	2 (0)	92 (27)	454
1712	CRAB ORCHARD LAKE	67 (20)	90 (27)	43 (13)	20 (6)	42 (12)	85 (25)	347
1714	LAKE DECATUR	40 (12)	13 (4)	53 (16)	33 (10)	30 (8)	32 (9)	201
1725	LONG LAKE	7 (2)	43 (13)	40 (12)	30 (9)	72 (21)	3 (1)	195
1726	LAKE LOU YAEGER	30 (9)	37 (11)	7 (2)	87 (26)	57 (17)	23 (7)	241
1727	LAKE MARIE	60 (18)	68 (20)	73 (22)	37 (11)	23 (7)	42 (12)	303
1733	PISTAKEE LAKE	27 (8)	68 (20)	23 (7)	13 (4)	90 (27)	32 (9)	253
1735	REND LAKE	77 (23)	80 (24)	70 (21)	50 (15)	53 (16)	92 (27)	422
1739	LAKE SHELBYVILLE	83 (25)	17 (5)	83 (25)	70 (21)	13 (2)	73 (22)	339
1740	SILVER LAKE (HIGHLAND)	20 (6)	47 (14)	10 (3)	97 (29)	13 (2)	42 (12)	229
1742	LAKE SPRINGFIELD	53 (16)	20 (6)	33 (10)	73 (22)	67 (20)	37 (11)	283
1748	VERMILION LAKE	50 (15)	3 (1)	47 (14)	43 (13)	37 (11)	47 (14)	227
1750	WONDER LAKE	13 (4)	50 (15)	20 (6)	7 (2)	80 (24)	13 (4)	183
1751	LAKE STORY	73 (22)	27 (8)	90 (27)	67 (20)	13 (2)	63 (19)	333
1752	DEPUE LAKE	10 (3)	10 (3)	3 (1)	23 (7)	83 (25)	10 (3)	139
1753	LAKE SANGCHRIS	88 (26)	30 (9)	67 (20)	57 (17)	30 (8)	97 (29)	369
1754	LAKE HOLIDAY	33 (10)	23 (7)	27 (8)	27 (8)	87 (26)	50 (15)	247
1755	FOX LAKE	23 (7)	63 (19)	17 (5)	17 (5)	72 (21)	20 (6)	212
1756	GRASS LAKE	17 (5)	53 (16)	50 (15)	10 (3)	97 (29)	17 (5)	244
1757	EAST LOON LAKE	70 (21)	100 (30)	97 (29)	53 (16)	2 (0)	77 (23)	399
1758	SLOCUM LAKE	3 (1)	87 (26)	13 (4)	0 (0)	100 (30)	7 (2)	210
1759	CEDAR LAKE	100 (30)	93 (28)	100 (30)	100 (30)	50 (15)	85 (25)	528
1761	LAKE HEMATUK	80 (24)	33 (10)	77 (23)	90 (27)	30 (8)	57 (17)	367
1762	RACCOON LAKE	57 (17)	73 (22)	30 (9)	60 (18)	42 (12)	68 (20)	330
1763	BALDWIN LAKE	93 (28)	97 (29)	87 (26)	80 (24)	47 (14)	100 (30)	504

19.

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1764	LAKE VANDALIA	47 (14)	60 (18)	60 (18)	83 (25)	13 (2)	60 (18)	323
1765	OLD BEN MINE RESERVOIR	0 (0)	83 (25)	57 (17)	40 (12)	60 (18)	0 (0)	240
1766	HORSESHOE LAKE	43 (13)	57 (17)	37 (11)	3 (1)	93 (28)	80 (24)	313

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1759	CEDAR LAKE	528
2	1763	BALDWIN LAKE	504
3	1711	COFFEEN LAKE	454
4	1735	REND LAKE	422
5	1757	EAST LOON LAKE	399
6	1753	LAKE SANGCHRIS	369
7	1761	LAKE WEMATUK	367
8	1712	CRAB ORCHARD LAKE	347
9	1706	LAKE CARLYLE	345
10	1739	LAKE SHELBYVILLE	339
11	1751	LAKE STORY	333
12	1762	RACCOON LAKE	330
13	1764	LAKE VANDALIA	323
14	1766	HORSESHOE LAKE	313
15	1727	LAKE MARIE	303
16	1703	LAKE BLOOMINGTON	296
17	1742	LAKE SPRINGFIELD	283
18	1733	PISTAKEE LAKE	253
19	1754	LAKE HOLIDAY	247
20	1756	GRASS LAKE	244
21	1726	LAKE LOU YAEGER	241
22	1765	OLD BEN MINE RESERVOIR	240
23	1740	SILVER LAKE (HIGHLAND)	229
24	1748	VERMILION LAKE	227
25	1708	LAKE CHARLESTON	225
26	1755	FOX LAKE	212
27	1758	SLOCUM LAKE	210
28	1714	LAKE DECATUR	201

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	1725	LONG LAKE	195
30	1750	WONDER LAKE	183
31	1752	DEPUE LAKE	139

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR ILLINOIS 10/23/75

LAKE CODE 1740 HIGHLAND SILVER LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 122.0

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1740A1	122.0	0.79	1.19	1.47	1.52	1.19	1.00	0.68	0.31	0.22	0.24	0.36	0.42	0.77
1740A2	100.8	0.65	0.98	1.21	1.25	0.98	0.82	0.56	0.26	0.18	0.20	0.29	0.34	0.63
1740ZZ	21.2	0.14	0.21	0.26	0.27	0.21	0.18	0.11	0.06	0.04	0.05	0.07	0.08	0.14

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 122.0
SUM OF SUB-DRAINAGE AREAS = 122.0

TOTAL FLOW IN = 9.32
TOTAL FLOW OUT = 9.32

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1740A1	6	73	2.29	3	1.36				
	7	73	0.40	8	0.31				
	8	73	0.12	5	0.0				
	9	73	0.06	1	0.0				
	10	73	0.0	13	0.0				
	11	73	1.13	4	0.18				
	12	73	1.93	1	0.71				
	1	74	4.62	5	1.13				
	2	74	3.37	16	0.01				
	3	74	1.30	2	1.44	16	1.44		
	4	74	0.79	6	1.33				
	5	74	3.00	4	0.31				
1740A2	6	73	1.90	3	1.13				
	7	73	0.31	8	0.25				
	8	73	0.10	5	0.0				
	9	73	0.11	1	0.04				
	10	73	0.11	13	0.31				
	11	73	0.91	4	0.15				
	12	73	1.56	1	0.57				
	1	74	3.77	5	0.93				
	2	74	2.78	16	0.45				
	3	74	1.08	2	1.19	16	1.19		
	4	74	0.65	6	0.91				
	5	74	2.46	4	0.26				
1740ZZ	6	73	0.40	3	0.23				
	7	73	0.08	8	0.06				
	8	73	0.02	5	0.0				
	9	73	0.03	1	0.01				
	10	73	0.03	13	0.04				
	11	73	0.23	4	0.03				
	12	73	0.37	1	0.14				
	1	74	0.85	5	0.20				
	2	74	0.59	16	0.04				
	3	74	0.23	2	0.25	16	0.25		
	4	74	0.14	6	0.42				
	5	74	0.54	4	0.05				

96.

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/10/23

174001
38 46 05.0 089 41 50.0
SILVER LAKE (HIGHLAND)
17119 ILLINOIS

11EPALES
3

2111202
0020 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/07	13	30 0000	16.7		10	195	7.60	54	0.150	1.000	0.890	0.084
	13	30 0006	16.7	7.7		195	7.70	53	0.100	0.900	0.870	0.083
	13	30 0015	16.6	7.1		195	7.70	53	0.110	0.900	0.880	0.081
	13	30 0024	16.3	5.4		200	7.50	55	0.120	1.100	0.930	0.068
73/08/10	17	10 0000	26.6	5.0	8	222	7.60	58	0.160	1.600	1.160	0.057
	17	10 0005	26.3			221						
	17	10 0012	26.1	4.8		220	7.30	59	0.110	1.100	1.200	0.050
	17	10 0017	21.3	0.4		219	6.90	79	0.920	2.500	0.200	0.109
73/10/17	14	32 0000	19.1			188	7.80	62	0.070	0.800	0.800	0.032
	14	32 0005	19.0	7.6		188	7.70	69	0.050	0.700	0.890	0.049
	14	32 0015	18.9			188						
	14	32 0021	18.7	7.8		188	7.70	72	0.100	0.700	1.000	0.041

27.

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/07	13	30 0000	0.227	1.3
	13	30 0006	0.226	
	13	30 0015	0.232	
	13	30 0024	0.255	
73/08/10	17	10 0000	0.197	1.4
	17	10 0012	0.187	
	17	10 0017	0.487	
73/10/17	14	32 0000	0.140	2.2
	14	32 0005	0.109	
	14	32 0021	0.107	

STORET RETRIEVAL DATE 75/10/23

174002
38 47 20.0 089 41 40.0
SILVER LAKE (HIGHLAND)
17119 ILLINOIS

11EPALES
3

2111202
0014 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/07	13	55 0000	16.7		10	185	7.60	52	0.180	0.900	0.680	0.082
	13	55 0006	16.7	6.5		185	7.00	56	0.110	0.900	0.720	0.070
	13	55 0010	16.6	6.0		185	7.50	55	0.180	0.900	0.700	0.078
73/08/10	17	35 0000	27.4	4.2	8	224	7.30	57	0.170	1.200	1.190	0.058
	17	35 0005	27.1			224						
	17	35 0010	26.8			224						
	17	35 0013	25.4	0.8		223	7.10	69	0.500	2.000	0.600	0.053
	17	35 0015	23.2	0.2		240	6.80	81	1.120	3.000	0.240	0.100
73/10/17	14	57 0000	19.1		12	191	7.70	74	0.050	0.800	0.850	0.035
	14	57 0015	18.8	7.4		190	7.60	75	0.060	0.600	0.840	0.036

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/07	13	55 0000	0.271	1.3
	13	55 0006	0.249	
	13	55 0010	0.238	
73/08/10	17	35 0000	0.182	2.9
	17	35 0013	0.387	
	17	35 0015	0.560	
73/10/17	14	57 0000	0.103	2.5
	14	57 0015	0.091	

STORET RETRIEVAL DATE 75/10/23

174003
38 48 30.0 089 40 50.0
SILVER LAKE (HIGHLAND)
17119 ILLINOIS

11EPALES 2111202
3 0008 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/07	14	10 0000	17.1		8	220	7.60	65	0.380	1.500	0.430	0.044
	14	10 0004	17.0	6.6		220	7.60	71	0.370	1.400	0.480	0.041
73/08/10	18	00 0000		5.6	8		7.30	60	0.190	1.500	0.980	0.051
73/10/17	15	12 0000	19.4		20	198	7.70	76	0.050	0.700	0.700	0.027
	15	12 0004	18.4	7.8		196	7.70	76	0.060	0.700	0.620	0.024

29.

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/07	14	10 0000	0.262	16.2
	14	10 0004	0.262	
73/08/10	18	00 0000	0.205	12.0
73/10/17	15	12 0000	0.102	12.6
	15	12 0004	0.097	

APPENDIX E

TRIBUTARY and WASTEWATER
TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/10/23

1740A1
38 40 55.0 089 41 55.0
E FORK SILVER CREEK
17139 MADISON CO MAP
O/HIGHLAND SILVER LAKE
ST HWY 143 BRDG 1 MI NW OF HIGHLAND
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/03	10 40		0.810	1.700	0.037	0.130	0.230
73/07/08	10 50		1.240	1.850	0.054	0.126	0.175
73/08/05	12 20		1.120	3.500	0.335	0.096	0.150
73/09/01	16 20		0.810	0.630	0.032	0.060	0.145
73/10/13	11 35		0.890	0.860	0.034	0.044	0.145
73/11/04	11 55		0.820	0.850	0.040	0.036	0.135
73/12/01	12 30		0.870	0.900	0.028	0.044	0.280
74/01/05	11 00		0.870	0.700	0.044	0.060	0.115
74/02/16	14 30		1.090	1.300	0.190	0.270	0.420
74/03/02	11 40		1.180	2.000	0.190	0.230	0.600
74/03/16	12 30		1.200	2.000	0.220	0.210	0.460
74/04/06	11 45		1.200	1.600	0.180	0.150	0.400
74/05/04	12 40		1.360	0.100K	0.035	0.115	0.304

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/23

1740A2
38 44 20.0 089 40 00.0
E FORK SILVER CREEK
17 MADISON CO MAP
I/HIGHLAND SILVER LAKE
ST HWY 160 BRDG .5 MI S OF GRANT FORK
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/03	11 05		0.460	2.200	0.018	0.037	0.310
73/07/08	11 20		0.460	2.520	0.020	0.040	0.230
73/08/05	13 30		0.310	3.300	0.240	0.092	0.280
73/09/01	10 40		0.042	2.100	0.042	0.038	0.210
73/10/13	12 05		0.130	1.530	0.189	0.024	0.125
73/11/04	12 45		0.320	1.000	0.126	0.027	0.065
73/12/01	13 15		0.780	1.800	0.216	0.690	1.100
74/01/05	10 00		2.600	1.300	0.140	0.352	0.430
74/02/16	11 30		1.800	1.800	0.290	0.220	0.390
74/03/02	12 50		1.370	1.400	0.138	0.160	0.345
74/03/16	11 40		0.704	2.500	0.125	0.315	0.710
74/04/06	12 50			2.500	0.130	0.170	0.550
74/05/04	11 30		0.216	0.160	0.160	0.025	0.140

STORET RETRIEVAL DATE 75/10/23

1740AA SF1740AA P000061
35 50 00.0 089 39 20.0
GRANTFORK COMMUNITY CENTER
17 250 BELLEVILLE
T/HIGHLAND SILVER LAKE
LITTLE SILVER CREEK
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/09/18	11 00								
CP(T)-			15.200	20.000	14.800	9.820	12.500	0.007	0.007
73/09/18	16 00								
73/10/18	11 00								
CP(T)-			47.000	16.750	6.900	7.800	10.500	0.007	0.007
73/10/18	16 00								
73/11/27	08 30		30.000	29.000	1.600	8.800	11.500	0.007	0.007
73/12/18	14 00		26.000	51.000	21.000	5.900	13.000	0.007	0.007
74/01/18	09 00		6.700	14.000		3.000	3.300	0.007	0.007
74/02/18	08 00		21.000	29.000	13.500	6.100	8.600	0.007	0.007
74/03/18	08 30		26.000	12.000	4.000	5.100	5.700	0.007	0.007
74/04/24	09 30		21.000	6.500		4.700	5.400	0.007	0.007
74/05/20	09 30		28.000	34.000	23.000	4.200	8.400		

3.3